DESIGN AND DEVELOPMENT OF A KNOWLEDGE-BASED FRAMEWORK FOR TROUSER PROCUREMENT: Bid Evaluation Software Tool (BEST)

Volume I: Executive Summary Technical Report

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13. ABSTRACT *(Maximum 200 words)*

Research has been carried out to design and develop BEST (Bid Evaluation Software Tool) a knowledge-based decision support system for evaluating the capability of an apparel manufacturer to perform on a contract. BEST has been developed in cooperation with major apparel manufacturers and has been successfully field-tested in collaboration with Levi Strauss & Company. BEST is implemented in Level-5 Object and runs under the MS-Windows environment on IBM-compatible personal computers.

This research effort has realized the vision of creating a knowledge-based decision support system for the objective evaluation of apparel contractors who can deliver the *right* quality product at the *right* time and at the *right* price. In doing so, it has pioneered the concepts of "vendor pre-qualification" and "vendor certification" central to effective and successful supply chain management. Finally, the "terms of engagement" module in BEST represents the first known successful effort to quantitatively assess the "working conditions" in apparel plants -- a key requirement as apparel manufacturing turns global.

This volume (the first of three volumes) documents the overall summary of the research effort.

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The American Apparel Manufacturers Association (AAMA) and several member companies of AAMA participated during the initial phase of the research and their contributions are thankfully acknowledged. During the second phase of the research effort, Levi Strauss & Company collaborated extensively and served as the "field test" site. In particular, Mr. Michael Morazzo of Levi's deserves sincere thanks and appreciation for his contributions.

Several technical specialists, contracting and procurement officers at the Defense Personnel Support Center in Philadelphia, PA, provided input during the course of the project. In particular, Ms. Diana Burton and Ms. Sally DiDonato deserve thanks for their participation.

Finally, Mr. John Adams and Ms. Susan Shows of AMTC provided the necessary administrative support during the project and their efforts are thankfully acknowledged.

* * *

Executive Summary

The Final Technical Report for the project entitled "Design and Development of a Knowledge-based Framework for Trouser Procurement" is being submitted in three volumes. The scope of the individual volumes is as follows:

Volume I Executive Summary Technical Report (**This Volume**)
[SJ-TR-PROC-9603]

Volume II Research Methodology
[SJ-TR-PROC-9603A]

Volume III Additional Reports and Papers
[SJ-TR-PROC-9603B]

* * *

1. Introduction

The Department of Defense is the single largest consumer of apparel items in the free world procuring approximately $1 billion worth of apparel every year. The buying organization, Defense Personnel Support Center (DPSC), typically receives bids from several companies that offer to supply the desired product. The process of determining whether a manufacturing enterprise is capable of producing the required *quantity* of the commodity at the right *time* and of the specified *quality* is fairly complex and involved.

Shift Towards Best Value Procurement: The old practice of using sealed bid procedures and awarding contracts to the lowest bidder is giving way to Best Value Procurement. Such an informed and knowledge-based procurement approach would not only help the government but would also have an overall beneficial effect on the apparel industry.

Importance to Apparel Industry: The practice of subcontracting some or all the operations involved in manufacturing products is prevalent in many industries, especially in the apparel industry. The buying organization typically receives bids from several companies that offer to carry out these operations. The process of determining whether a manufacturing enterprise is capable of producing the required quantity of the commodity at the right time and of the specified quality is fairly complex and involved.

Need for Research: Therefore, a knowledge-based approach that can objectively identify the major factors affecting the capability of an apparel manufacturing enterprise and assess the

effect of these factors on the overall possibility of obtaining a quality product at the right time will greatly enhance the source selection process in the Government and in the industry.

2. Research Objectives

The primary objective of this research effort has been to design and develop a knowledge-based framework to facilitate the objective evaluation of an apparel enterprise to deliver the right quality goods at the right time and at the right price. The second objective has been to implement this tool as a knowledge-based decision support system and to test and evaluate its effectiveness with industry participation. The third objective has been to disseminate the benefits of this knowledge-based approach to source selection to DPSC and to the industry at-large.

3. Research Accomplishments

The major research accomplishments are summarized in this section. Additional volumes provide in-depth information about the various endeavors.

3.1 Apparel Enterprise Evaluation Framework

The key factors contributing towards the overall capability of an enterprise to produce quality output in a short throughput time have been identified through an expert knowledge acquisition process consisting of an industry questionnaire, interactions with apparel contracting experts in industry and DPSC, and literature. This input from contracting officers in the industry and the government, i.e., the experts, was analyzed and used to develop the

knowledge-based framework for evaluating the enterprise (Figure 1); it resulted in the Apparel Enterprise Evaluation Framework (AEEF). Simultaneously, a framework for classifying sewing machines based on technological capabilities was developed for AEEF.

3.2 Decision Support System: The Initial Version

AEEF was then implemented in Neuron Data's Nexpert Object and led to BEST -- Bid Evaluation Software Tool -- a decision support system for evaluating apparel contractors objectively. BEST ranked companies on a scale of 0-4 based on the ability of the company or contractor to meet the evaluation criteria of quality, production and financial capabilities. It was tested extensively to prove the feasibility of a knowledge-based approach to procurement and source selection. As with any major KBS development effort, BEST was initially targeted to a significant, yet manageable, domain, viz., trousers. The scope was broadened in the second phase of the effort to make the system a "generic" tool for any apparel item.

3.3 BEST: Bid Evaluation Software Tool

During the second phase of the research effort, the original scope of BEST was broadened beyond trousers to make it a *generic* evaluation tool for any apparel item. Also, the original implementation of BEST in Nexpert Object was ported to the Windows platform using Level-5 Object software.

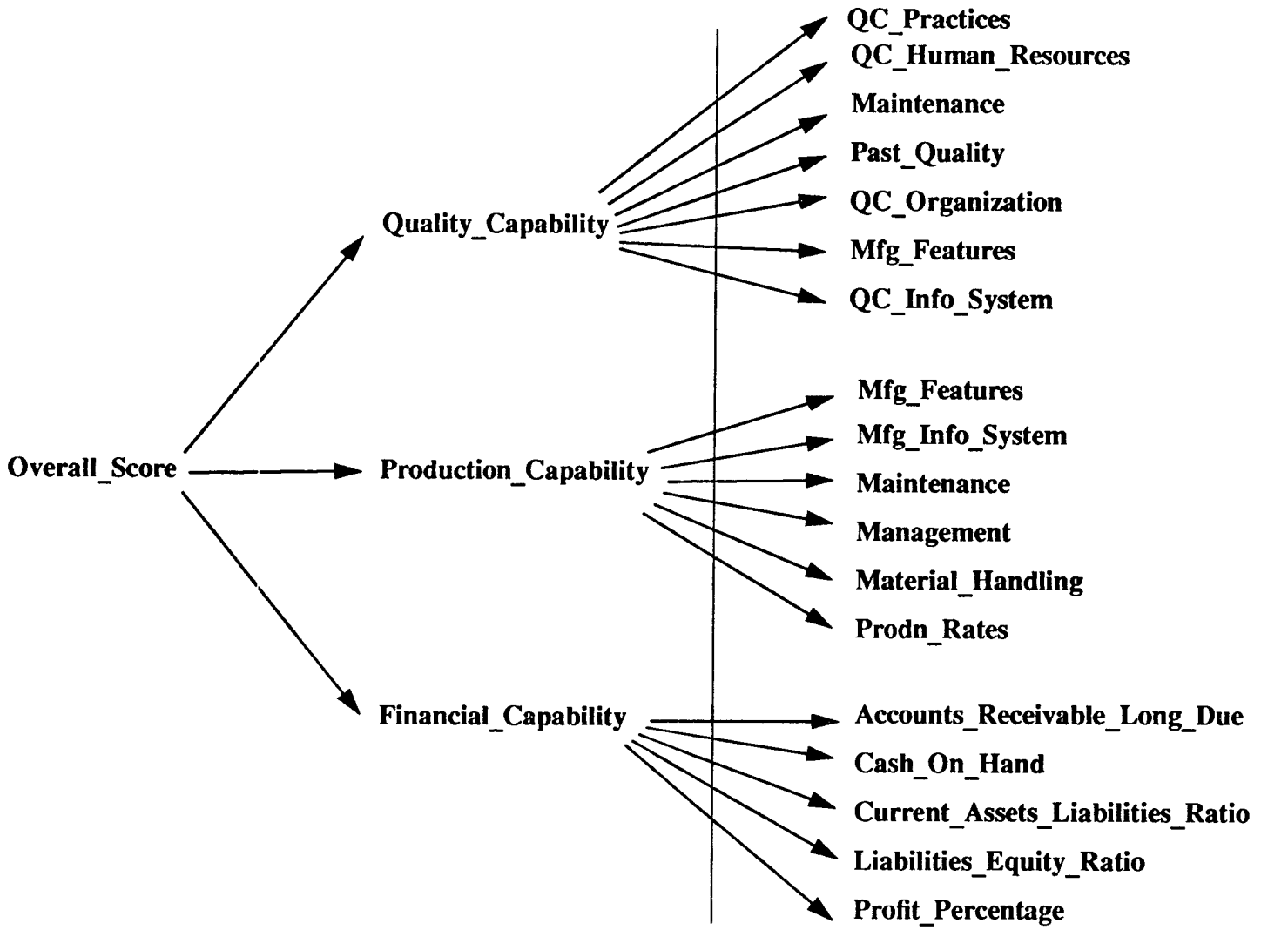

Figure 1 Decomposition of the Class *Overall_Score*

BEST consists of two principal modules -- BESTForms and BESTProcess. BESTForms is used to obtain the necessary information for evaluating a bidder, while BESTProcess is the reasoning module that utilizes the data in BESTForms to arrive at an overall score for the bidder.

BESTForms: BESTForms can be customized by the evaluating officer to suit the garment being procured. This customization can be accomplished through a graphical user interface (GUI) designed with on-line help. As shown in Figure 2, each form seeks information on one aspect of an apparel enterprise. For example, in Figure 3, information about the Sewing Room is sought from the bidder. Figure 4 shows a screen from the Spreading & Cutting Room Form. Along with the bid solicitation, disks containing BESTForms can be mailed by the evaluating officer. The bidders can easily enter the information on the disk (or on a hard copy) and send it back with their bids.

The evaluating officer can also assign suitable weights for the various evaluation parameters pertaining to the procurement. Likewise, the parameters associated with the contract can be assigned by the officer. In short, BESTForms provides a great deal of flexibility to the officer in tailoring BEST to suit a specific procurement. BESTForms is also available in hard-copy form.

BESTProcess: BESTProcess, the problem-solving engine in BEST, utilizes the data in BESTForms, the weights and parameters assigned by the evaluating officer and comes up with an overall score (on a 0-4 scale) for the bidder (Figures 5 and 6). The evaluating officer

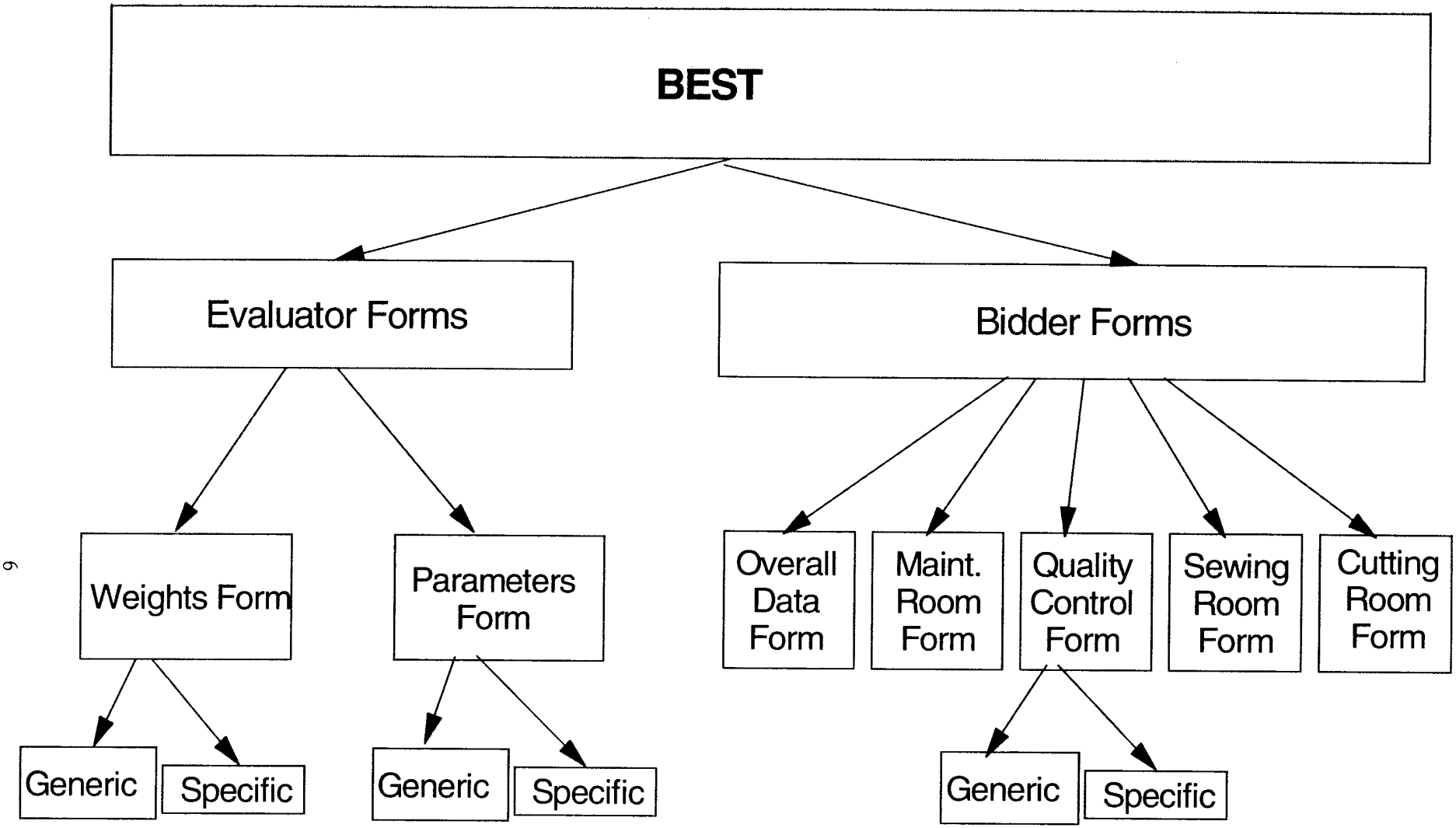

Figure 2 The BEST System

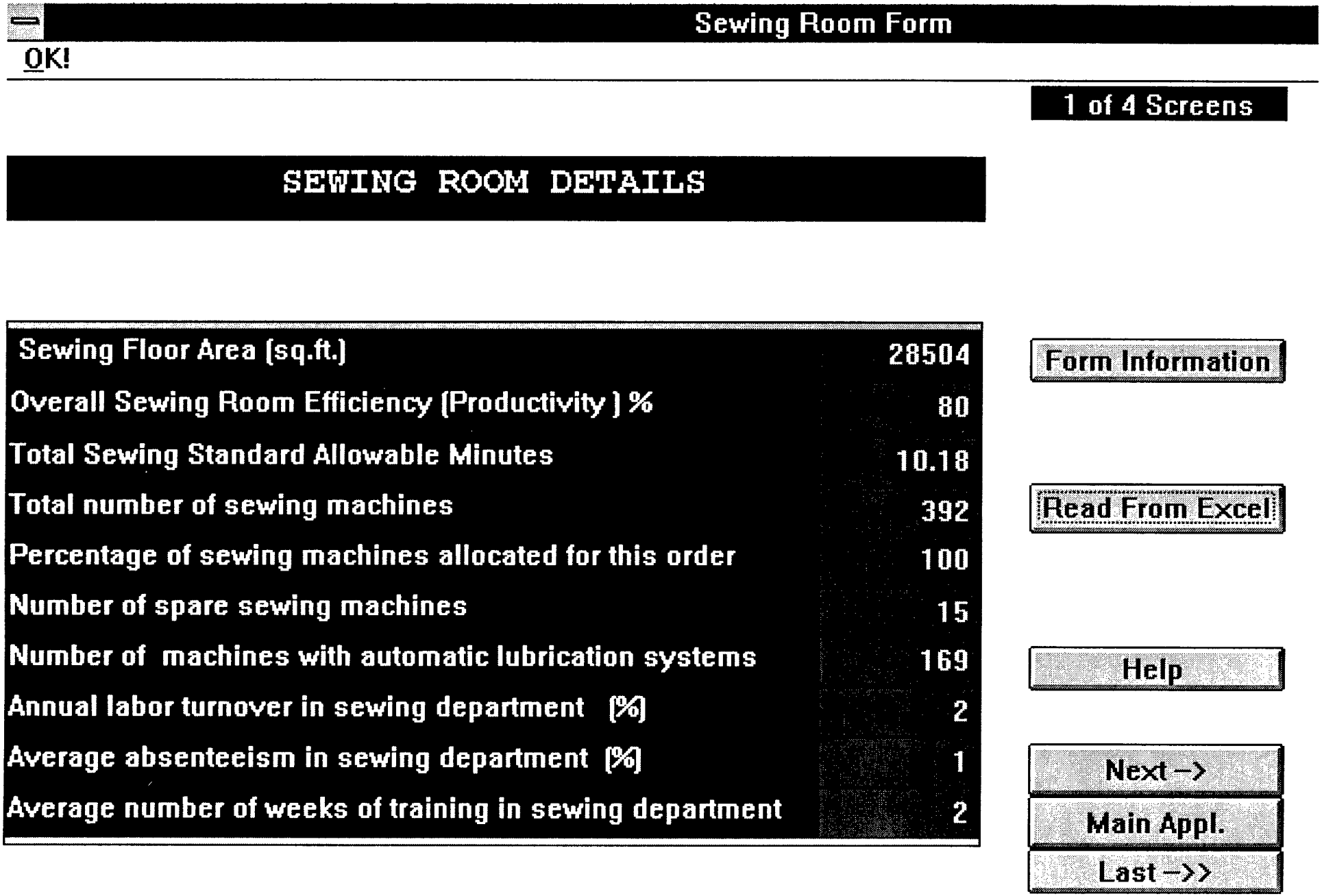

Figure 3 . A Screen From the Sewing Room Form

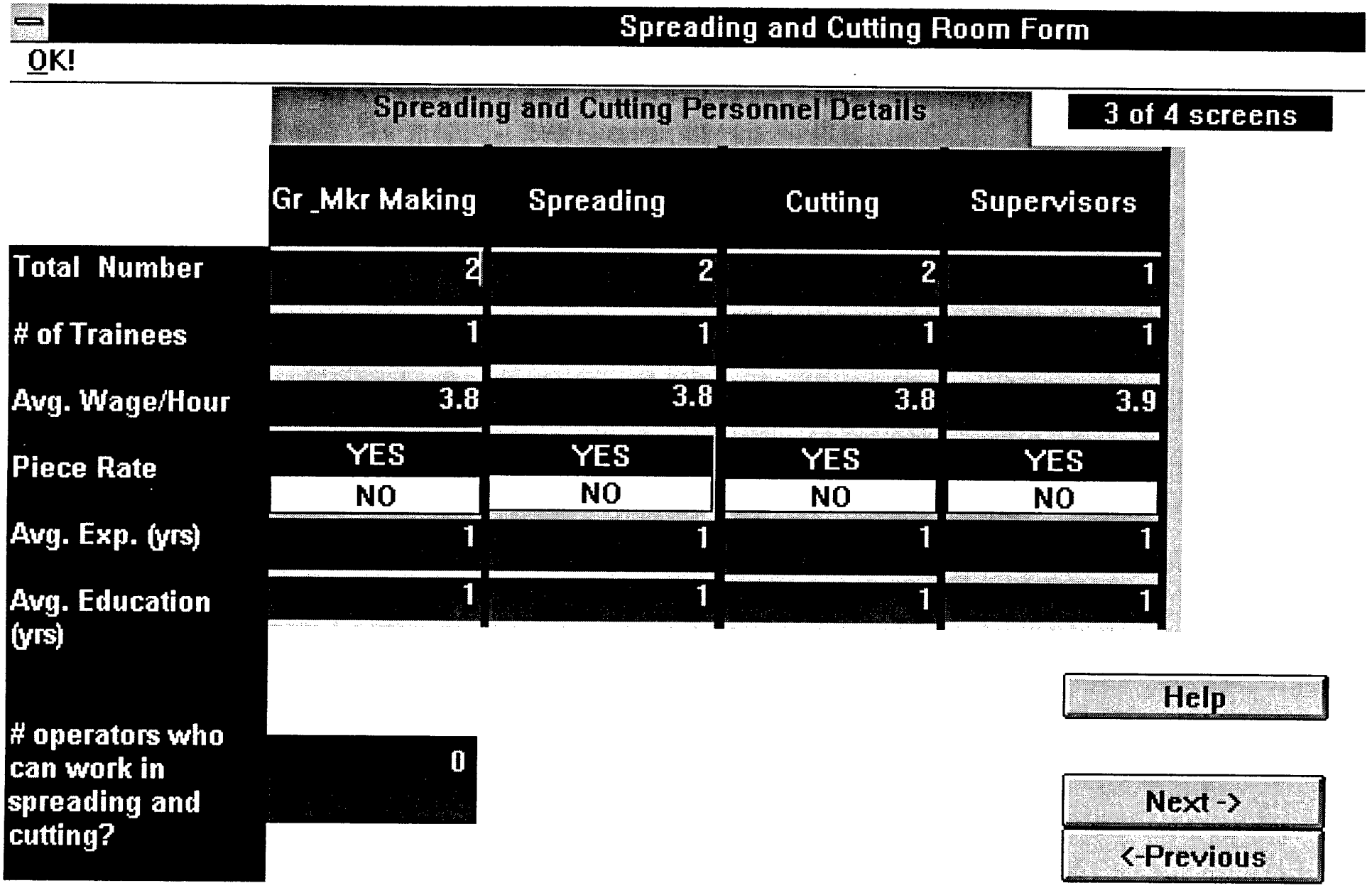

Figure 4. A Screen From the Spreading & Cutting Form

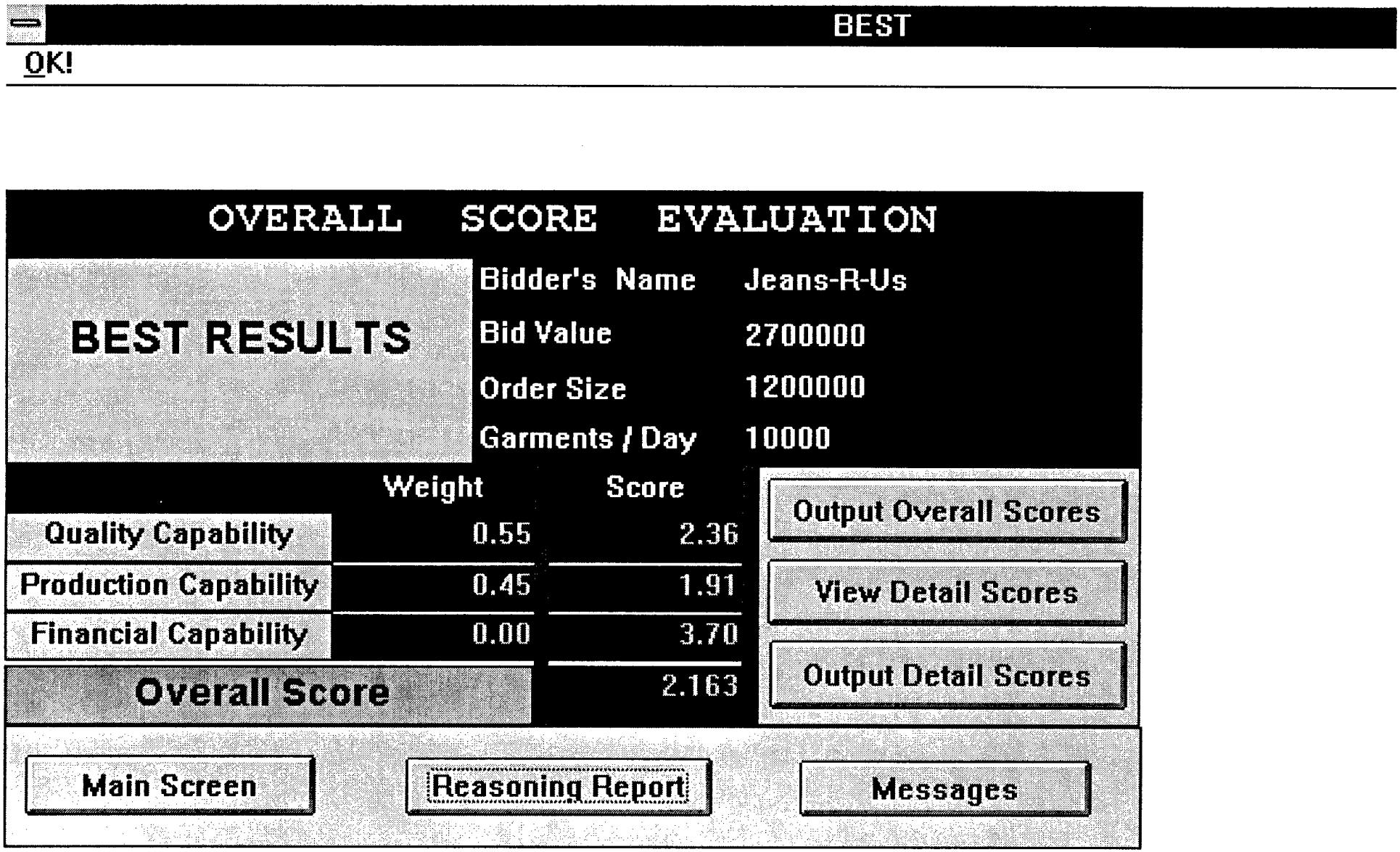

Figure 5 BEST Results

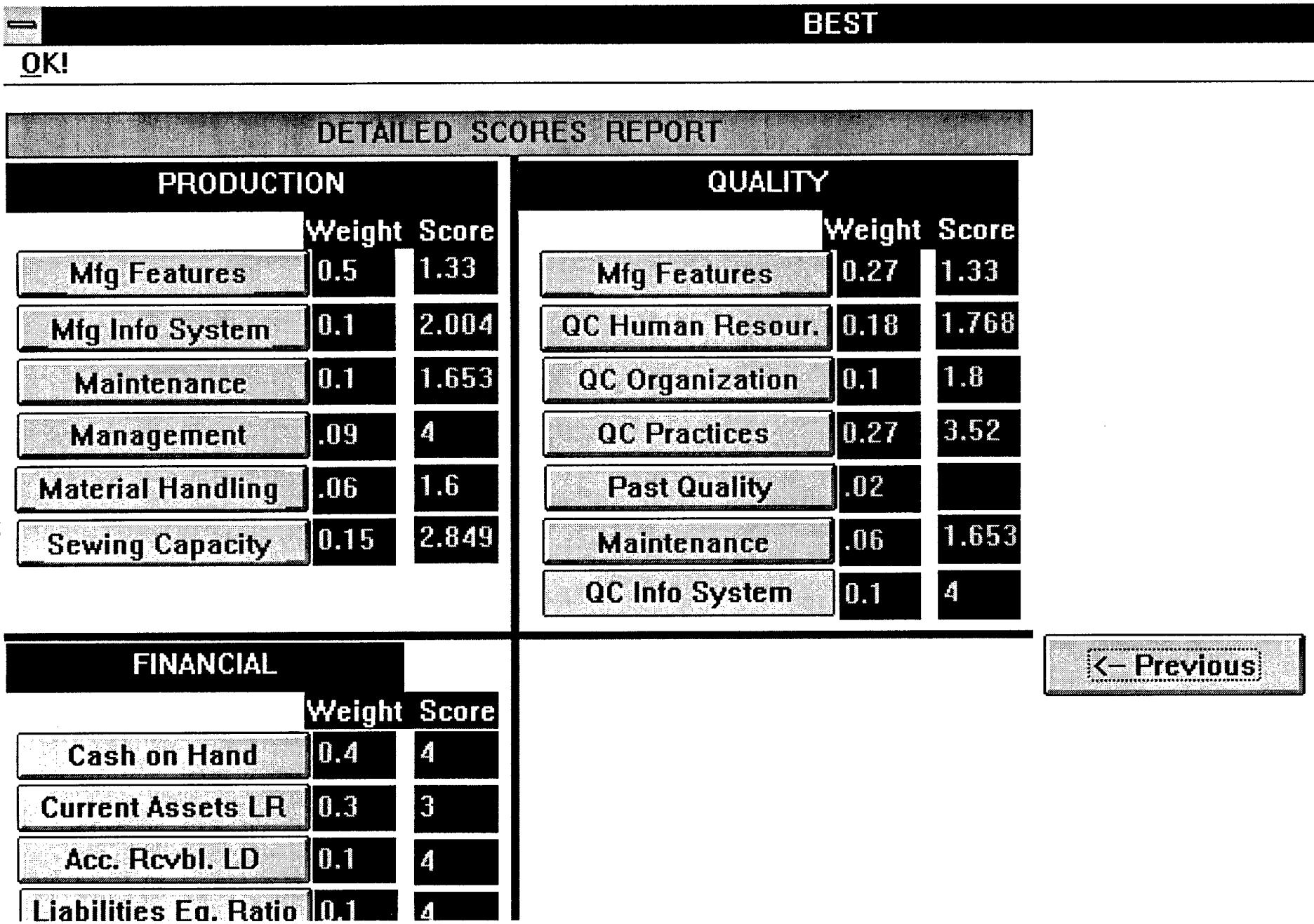

Figure 6 Detailed Distribution of BEST Results

can also assign suitable weights for the various evaluation parameters pertaining to the procurement. Likewise, the parameters associated with the contract can be assigned by the officer. In short, BESTForms provides a great deal of flexibility to the officer in tailoring BEST to suit a specific procurement. BESTForms is also available in hard-copy form.

Field Testing of BEST: Collaboration with Levi Strauss & Company: BEST has been tested and validated with the participation of Levi Strauss & Company. Using BESTForms, the contracting expert at Levi's gathered data from apparel plants which were subsequently processed through BEST. The ranking of the firms by BEST was identical to that of the human expert thus validating the reasoning process in BEST. The expert was able to easily alter the weights and parameters using the GUI to suit the specific procurement and confirmed the system's ease of use. The contracting expert also reviewed and validated all the weights and parameters in BEST. Thus, the field testing of BEST has been successful and it has been validated in the field. Furthermore, the field testing conclusively demonstrated the capability of BEST as an effective tool to aid source selection for the Government and the commercial industry.

BEST and Oxford Shirtings: Once the field testing was successful and BEST was validated, efforts were initiated by Oxford Shirtings to test and use BEST for their source selection.

3.4 The Terms of Engagement Module

Working in collaboration with Levi's, a "terms of engagement module" (TOE) was developed and integrated into BEST, resulting in SuperBEST. Using the information on the plant obtained through a set of TOE Forms, the TOE module assesses the "working conditions" in an apparel plant and ranks it on a scale of 0-4. This score is then integrated into the BESTIndex resulting in a SuperBESTIndex. Moreover, if a company used child labor, prison labor or pays the employees below the minimum wage, the TOE module "flags" the violations for the user. Thus, the TOE module can help companies and compliance authorities (e.g., the US Department of Labor) identify "sweatshops" that might be used for making garments.

3.5 Information Dissemination

Information on the project activities has been widely disseminated through presentations at industry meetings and conferences, and through publications (in trade and refereed journals) and briefings to the Government including one to the DPSC Clothing & Textile Board Chaired by Maj. Gen. Henry. A one-day Seminar on BEST was organized at Georgia Tech with the participation of Bobbin Magazine, the leading apparel industry trade publication.

4. Role and Importance of BEST in Apparel Procurement

BEST has been developed to provide a knowledge-based decision support system for contracting officers at DPSC to assist them in their evaluation tasks. Using BEST, officers can apply the evaluation criteria uniformly, and objectively, across all bidders. Moreover, for the bidders, the bid preparation process will be greatly simplified (and automated) since the

information is sought in a logical and consistent format (in BESTForms) from all bidders.

BEST also has a potential role in DoD's moves towards *electronic commerce* (EC). BESTForms represents a modest step in paving the way for electronic data interchange (EDI) between DoD and its apparel suppliers. The concept can be extended to EDI between commercial apparel companies involved in sub-contracting. Bidders can conceivably submit the necessary information on disks that can be loaded at DPSC and used with BEST. Such an approach will reduce the large amounts of existing paperwork and will contribute to fewer errors in data transfer. Data integrity can be easily ensured prior to the award of a contract. Additionally, once a bidder's information is present in a database at DPSC, the bidder will only be required to update the information (on subsequent bids) and there will be no need to resubmit all the data. Moreover, in the event of a mobilization (e.g., Desert Shield/Storm), DPSC would have a database of contractors' capabilities that could be quickly tapped. In the long-term, DPSC can utilize the proposed national *information superhighway* to set up a network (or dial-in) facility and bidders can enter the information directly in DPSC's computers thus speeding up the response process on a solicitation. Thus, BEST can play a critical role in facilitating EDI leading to EC between the government and its contractors over the Internet or the World Wide Web.

BEST Index and Civilian Apparel Manufacturers: Since a large number of apparel companies (in the civilian market) are actively engaged in subcontracting, BEST can assist them in evaluating potential contractors. In the long term, an index similar to the Department

of Transportation's ranking of airline performance (based on on-time arrival, baggage handling and customer complaints) can be developed for the apparel industry. Such an index can be maintained by an independent agency (similar to the Underwriter Laboratories for appliances). And apparel companies can use the BEST Index as a reliable indicator of contractor performance to select contractors.

5. Conclusions

In conclusion, the research effort has realized the vision of creating a knowledge-based decision support system for the objective evaluation of apparel contractors who can deliver the right quality product at the right time and at the right price. In doing so, it has pioneered the concepts of "vendor prequalification" and "vendor certification" central to effective supply chain management. Finally, the "terms of engagement" module in BEST represents the first known successful effort to quantitatively assess the "working conditions" in apparel plants -- a key requirement as apparel manufacturing turns global.